

HAZARDOUS WASTE

Electronics, Lead, and Landfills

Ironically, some of our most advanced technologies, when discarded, may represent a rapidly expanding and sometimes unregulated exposure to a toxicant that plagued even the ancient Romans: lead. Almost all electronic devices contain lead, and such devices are proliferating—and becoming obsolete—at breathtaking speed. A University of Florida environmental engineer is researching the potential environmental fate of the lead found in electronics sent to landfills. In a report sponsored by the U.S. Environmental Protection Agency (EPA) and issued 15 July 2004, Timothy G. Townsend described his study of 12 different types of electronic items and his finding that the items leached lead at concentrations exceeding the EPA threshold for categorizing a waste as hazardous.

Townsend's goal is to help landfill regulators and managers decide how to allocate scarce resources. He explains, "Maybe they have to choose what type of waste to recycle—tires or electronics?" By discovering whether electronics leach toxic chemicals, he says, "we might help a community decide." He focused on testing for lead because it happens to extract well under the test procedure he used—which is modeled on landfill conditions—and thus may be likely to leach from a landfill.

Townsend's report, *RCRA Toxicity Characterization of Computer CPUs and Other Discarded Electronic Devices*, expanded on his earlier research on cathode ray tubes (CRTs) used in computer monitors and televisions. CRTs contain an average of about four pounds of lead. There are smaller quantities in the solder used in other electronic devices.

Townsend performed an EPA test known as the toxicity characteristic leaching procedure (TCLP) on a variety of electronic items including computer CPUs

(central processing units), televisions, videocassette recorders, printers, cellular phones, remote controls, computer mice and keyboards, and smoke alarms. The TCLP test determines the mobility of analytes present in waste. Following the protocol, the devices were ground up, mixed with an acetic acid-based simulated leachate fluid, and rotated in a drum container for 18 hours, after which the leachate was tested for metal concentrations. In the TCLP, lead concentrations above 5 milligrams per liter are considered hazardous. All the devices Townsend tested



Obsolete and overflowing. Certain electronic items have become practically disposable, and are tossed into landfills as soon as the newest version arrives. Once there, however, are they leaching lead at hazardous rates?

leached lead over this threshold under some conditions.

But is the lead that is actually in landfills a health threat? "It has never been shown that lead is actually leaching out of landfills," says Fern Abrams, director of environmental policy at IPC—Association Connecting Electronics Industries, an industry group based in Northbrook, Illinois. And although lead is known to be present in landfills, some of it may come from other constituents. "Electronics in general are one percent of the waste that goes into a landfill," says Jan Whitworth, a policy analyst with the Oregon Department of Environmental Quality. So if lead

were to be found in leachate, it would be very hard to say for sure whether it had come from electronics.

Even so, the European Union has banned lead solder in certain electronic devices beginning in 2006, due to landfill concerns. California already bans disposal of CRTs and televisions in household waste landfills. Oladele Ogunseitan, an associate professor of social ecology at the University of California, Irvine, who is evaluating the phaseout of lead solder, thinks it makes sense to allow manufacturers to use hazardous materials when alternatives are not available, but to require recycling. Today, many computer manufacturers will recycle discarded computers, but often will charge a fee.

Others believe hazardous substances must be removed from products altogether. Mamta Khanna, pollution prevention program manager at the nonprofit activist Center for Environmental Health in Oakland, California, would like electronics manufacturers to take cradle-to-grave responsibility for their products. "Once they have to bear the burden of disposal, they will use less hazardous materials," says Khanna. "Why wait for years of study to determine when these toxic materials will start leaching and poisoning us, when electronics makers can start using safer materials today?" Khanna also points out that electronics waste is associated with other potentially toxic chemicals, including mercury, chromium, and brominated flame retardants.

To simulate landfill conditions more accurately than can be done in a lab with the TCLP, Townsend is now conducting an experiment in which he has buried garbage and electronics waste. Simulated rainfall is added periodically, with leachate forming as the water percolates through the waste. Results will be available in about two years. Next year the EPA expects to issue a rule limiting how CRTs can be disposed of nationwide, according to agency environmental protection specialist Marilyn Goode. —Valerie J. Brown

LEAD

Washington's Water Woes

For at least two years the concentration of lead in Washington, D.C., drinking water has dramatically exceeded the action level at which the Safe Drinking Water Act requires water systems to address the problem. By this summer, additional steps had been taken to address water quality through treatment, but these steps will take months to become fully effective. Indeed, the controversy surrounding the problem resembles the plot of a political potboiler, and blood tests and water filters are still hot topics among Washingtonians.

Of approximately 130,000 residences served by the District of Columbia Water and Sewer Authority (DCWASA), an estimated 18% have lead service pipes. Lead is in some older solder and plumbing fixtures as well. Paint and dust remain the main sources of lead exposure in the United States, but on average 10–20% of U.S. environmental lead exposure comes from drinking water, according to the EPA. (Experts largely agree, however, that the Safe Drinking Water Act amendments have greatly reduced exposure from the lead service pipes that still serve many households in older communities throughout the country.) Lead exposure impairs intellectual and physical development in fetuses and young children. In adults, it appears to increase the risk for hypertension and kidney disease.

Under the Lead and Copper Rule of the U.S. Environmental Protection Agency (EPA), water systems are required to develop a plan to lower lead levels if 10% of residences tested exceed 15 parts per billion (ppb). According to Alexandra Teitz, minority counsel for the House Committee on Government Reform, 73% of one set of water samples from Washington homes exceeded the action level, with numerous samples exceeding 100 ppb and some exceeding 300 ppb. Moreover, before 2002, DCWASA was required to test only 50 residences each year.

Washington's recent water quality troubles may have begun as early as November 2000. That's when health officials, with the EPA's approval, stopped using chlorine disinfection because of its by-products. The city switched to a chlorine-ammonia compound called chloramine to disinfect the water, while using pH adjustments to control corrosion. Unbeknownst to scientists

and water utilities at the time, says Johnnie Hemphill, interim director for public affairs at DCWASA, pH adjustments are not as effective without chlorine. The absence of chlorine was not implicated until 2004—water system officials used chlorine in April and May of that year, and lead levels temporarily dropped, says Hemphill.

Consumers were first informed of the elevated lead levels in October 2002 via water bill inserts and a mailed brochure—means that some critics say tended to downplay the situation. As Hemphill explains it, the EPA then demanded that DCWASA explain whether it had failed to adequately monitor for lead or to adequately alert the public and the EPA about the elevated levels.

At the same time, members of Congress charged the EPA with failing to adequately protect the country's drinking water. "The District and its residents were unknowingly forced to serve as a 'canary in the coal mine' for lead in drinking water," asserted Representative Henry Waxman (D-California) in a statement presented at a congressional hearing in May 2004. "We have now been clearly warned about the flaws in our national program on lead in drinking water."

In June, officials in Washington began adding phosphoric acid, a food additive, to a small portion of the system to protect the pipes. In July, DCWASA accelerated its timetable for replacing its lead service lines, promising to complete the job by 2010 (under EPA regulations, water systems need replace only a small percentage of public service lines per year and may approve lines using lead testing in lieu of actual pipe replacement). The city is offering loans to those residents who want to replace the part of the line on their property, which is the homeowner's responsibility.

Blood tests, which the city has offered for free to residents, are indicating that the number of Washingtonians with high blood lead levels has not increased, Hemphill says. But this good news is overshadowed by studies showing that even at blood levels below the current cutoff of 10 micrograms per deciliter ($\mu\text{g}/\text{dL}$), lead can lower children's IQ and cause behavior problems, says Lynn Goldman, an environmental health scientist at The Johns Hopkins University. A task force from the Centers for Disease Control and Prevention is considering recommending that the cutoff be lowered to 5 $\mu\text{g}/\text{dL}$, although Goldman notes that many experts think there is no threshold for the toxic effects of lead. —**Tina Adler**

Scratching Out Data on Animal Antibiotic Effects

Farmers use antibiotics to help keep livestock healthy and make them grow faster. Because of concerns that this practice encourages microbial resistance to these drugs, the GAO studied research needs and federal agency efforts on the problem. The GAO's April 2004 report found that agencies lack the data on linkages between antibiotic use in animals and emerging resistant bacteria that are needed to support research on human health risks. It recommended that the FDA expedite risk assessment of drugs used in animals that are also critical for human health, and that a plan be developed and implemented to fill data gaps in this area.



Counting Hydrocarbs to Curb U.S. Oil Hunger

In analyzing U.S. fossil fuel consumption, a Cornell University team has determined that energy conservation, along with the development and implementation of energy-efficient technologies, could save consumers \$438 billion per year by 2014; conserve chemicals, paper, lumber, and metals; and reduce energy consumption by 33%—just over the amount provided by annual U.S. oil imports. In the June 2004 issue of *Environment, Development, and Sustainability*, the team reported that government subsidies of traditional energy industries, which cost American families about \$410 each year in taxes, keep fuel prices artificially low, thus encouraging greater consumption and importation.

Obesity Report Cards

In June 2004, as part of a state antiobesity program, the nonpartisan Arkansas Center for Health Improvement began mailing annual health reports to the parents of all 450,000

Arkansas public school students. Schools submit each child's weight and body mass index to the center, which then notifies parents of their child's weight category and provides healthy lifestyle tips. The center found that 40% of the state's children are either overweight or at risk for becoming so. Arkansas has also banned vending machines from elementary schools and set up school nutrition, exercise, and child health advisory committees.



ASTHMA

Smoking Clouds Treatment Benefits

Although there are numerous ways children with asthma and allergies can reduce attacks and live a more normal life, researchers at the 2004 annual meeting of the American Academy of Allergy, Asthma, and Immunology (AAAAI) in San Francisco said cigarette smoking in the home virtually negates those interventions. “The data are clearly there,” said Robert Holzhauer, a clinical assistant professor of pediatrics at the University of Rochester School of Medicine and Dentistry. “We have unequivocal data to show that sidestream smoke is dangerous to people with asthma.”

In one study presented at the March meeting, Holzhauer and colleagues identified Rochester schoolchildren aged 3–7 who had mild persistent to severe persistent asthma. Children were assigned randomly to school-based care groups. One group received daily inhaled corticosteroids—a proven, effective treatment to prevent asthma attacks—at school, while the other did not.

Children in the treated group had fewer attacks and school absences; their parents reported fewer worries about their children's health, work absences, and unexpected changes in plans. But if there was smoking in the home, those advantages were almost completely nullified. These findings have since been published in the May 2004 issue of *Archives of Pediatrics and Adolescent Medicine*.

In another presentation, Dennis Ownby, chief of allergy and immunology at the Medical College of Georgia, described his examination of the relationship between exposure to cats and dogs during the first year of life and the risk of allergy at age 6–7 years. He selected a birth cohort of 474 children, who were classified as having no exposure to cats or dogs during the first year of life, exposure to 1 cat or dog, or exposure to 2 or more cats or dogs.

Children of nonsmoking parents were significantly less likely to have allergies if they were exposed to 2 or more cats or dogs; about 14% of these children were allergic, compared to 37.5% of children with 1 pet and 36.8% of children with no pets. But this benefit was not seen in children of smoking parents. “This research shows that cigarette smoking is not innocuous to young children,” Ownby said. “We see evidence that it's affecting their immune system.”

Holzhauer said parents must be convinced of how important it is to stop smoking in the home if they have children with asthma. However the doctors stopped short of advocating persuasion through legislation. “I think that if we were to report these parents to the authorities for child abuse, we would lose the children as patients,” Holzhauer said.

Rather, Kathleen Sheerin, a private-practice allergy specialist and chair of the AAAAI Public Education Committee, suggested that pediatricians and other health care professionals more strongly emphasize to parents the link between asthma, allergies, and smoking. She said, “We counsel parents to go to another room to smoke or to go outside if there is a child in the house.” —**Ed Susman**

AGRICULTURE

Tracking Antibiotics in Groundwater

Antibiotics are commonly used in food animal production to treat illness, promote growth, and ward off disease. These drugs and their metabolites appear in animal wastes and can eventually enter ground and surface waters following the common practice of applying manure to agricultural fields. Given that low levels of antibiotics can promote the development of microbial drug resistance, their presence in ground and surface waters constitutes an environmental health concern. Current methods for measuring trace amounts of antibiotics in water samples are costly and time-consuming, but researchers now show that a common food-test kit yields comparable information quickly and cheaply.

Researchers led by Kuldip Kumar at the University of Minnesota describe in the January–February 2004 *Journal of Environmental Quality* their use of the kits, which rely on the enzyme-linked immunosorbent assay (ELISA), a widely used technique based upon antibody recognition of target compounds. Food inspectors use the kits to test for drug residues in meat and milk. Using the

kits, the researchers found trace amounts of tylosin, tetracycline, and chlortetracycline in surface and ground waters, field runoff, and swine manure. These results were confirmed with liquid chromatography–mass spectrometry (LC-MS). “Our bigger [question] is whether this small concentration of antibiotics in the environment is producing antibiotic-resistant bugs,” says Kumar.

The researchers, who are among the first to employ ELISA to test environmental samples for antibiotics, say the assay is as sensitive as LC-MS for detecting target compounds in parts per billion, but is quicker, easier, and less expensive (\$5–15 per sample, compared to about \$150 for LC-MS, including sample

preparation and instrumentation). However, ELISA would best serve as a screening tool rather than a means of precise quantitation, because structural similarities between antibiotics, their metabolites or degradation products, and other compounds can yield false-positive results due to cross-reactivity. For example, the tetracycline test used by the researchers detected not just that drug but also several others in the same class.

Chemist Diana Aga of the University at Buffalo, who has also used ELISA to detect antibiotics in environmental samples, concurs that cross-reactivity is its key limitation. “This method shouldn't be the basis of any policy making because ELISA is a semi-quantitative technique,” she says. “It's a good technique because it is cheap and easy and fast, but it could also give you some false-positives or overestimate results.”

Despite this limitation, ELISA is a useful tool, says Ching-Hua Huang, an environmental engineer at the Georgia Institute of Technology. Researchers might use it to rapidly evaluate the presence of antibiotics in the environment, identify hot spots, and use the information for further studies. There is little dispute that antibiotics are in our source waters, says Huang—the question now is whether, and how, these compounds are linked to adverse effects in the environment. —**Julia R. Barrett**



Farm folly? Animal antibiotic use may contribute to microbial resistance, making it important to track these drugs in the environment.

ehpnet

Environmental Technology Opportunities Portal

In 2003, Congress mandated that the U.S. Environmental Protection Agency (EPA) set up a centralized office for facilitating public-private partnerships established to commercialize cost-effective environment-related technologies. As part of this effort, the EPA has created the Environmental Technology Opportunities Portal (ETOP), located at <http://www.epa.gov/etop/>, where technology developers can access the numerous programs—financial and otherwise—that the EPA offers them. The site is designed to help developers understand EPA programs on offer so that they can better take advantage of the money and other resources available through these programs.

The site has three primary sections. The largest is the For Technology Developers section. From this section, visitors can go to subsections to learn more about getting financial support, finding ways to demonstrate and verify their technologies, marketing their products, disseminating information, building partnerships, and advocating for their innovations.

The Financial Support subsection of this page includes information not just about EPA sources, but also about monies available from other federal agencies and the private sector. The Demonstration/Verification subsection has links to various programs designed specifically for field-testing and otherwise demonstrating new technologies in certain areas, such as the Superfund Innovative Technology Evaluation Program.

The Marketing subsection provides links to the VENDINFO database of pollution prevention equipment, products, and services, as well as to marketing/labeling programs such as Energy Star. Finally, the Information, Partnership, and Advocacy Programs subsection includes links to resources such as the EPA's Technology Innovation Program, an information and advocacy group that promotes the use of new technologies in remediation of a variety of polluted sites. This program works with other federal agencies, states, engineering firms, responsible parties, investors, and developers to provide technology and market information and to facilitate the implementation of these innovations.

Back at the homepage, the Technology Users section of the ETOP site connects those searching for environmental technologies to appropriate solutions, sorted by type: air, water, solid and hazardous waste, and pollution prevention. Included is information on EPA research and development activities. This section also provides the Thesaurus of Environmental Technology Terms, a compendium of relevant terminology, technologies, programs, and offices.

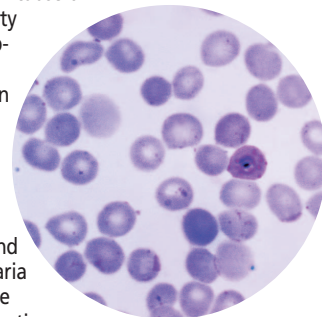
The ETOP site offers a number of features on its homepage to help ensure that visitors can easily get the information they need. The Where You Live link leads to an interactive map that allows visitors to pull up information by EPA region or state (the map currently contains information just for Region 1). Visitors can also subscribe to two mailing lists: the ETOP mailing list provides information about funding opportunities as they are announced and updates to the ETOP site, while the EnvirotechNews mailing list features a calendar of upcoming events, information on federal funding opportunities, and items on enforcement actions. Finally, ETOP News pulls together news items of interest to the environmental technology developer community, such as the recent awarding of \$900,000 to four companies to develop environmentally relevant nanotechnologies. —Erin E. Dooley



Protein Discovery Sparks Hope for Malaria Vaccine

An international team of researchers reports finding a protein, PfEMP1, on the surface of red blood cells in young children infected with severe malaria, a major cause of morbidity and mortality among children in sub-Saharan Africa. This variant surface antigen could be the target for a vaccine to help children build up antibodies against the disease.

PfEMP1 is not found in other forms of malaria or in older people. Like other variant surface antigens, it enables infected cells to remain in the blood stream and reproduce, rather than being removed by the spleen. The report was published 3 May 2004 in *The Journal of Experimental Medicine*.



Renewed Commitment to Renewables

At June's Renewables 2004 conference, a follow-up to the 2002 World Summit on Sustainable Development, representatives from 154 governments pledged anew to promote alternative energy sources, and the World Bank announced it will double loans for renewables projects by 2010. A total of 192 commitments were announced. Currently renewables make up only 5% of the world's energy supplies.

Meeting attendants also adopted a political declaration, including a vision for equitable access to energy and increased energy efficiency. UNEP estimates that some 1.6 billion people do not have access to electricity. UNEP director Klaus Töpfer cited "energy poverty" as contributing to poverty overall and the associated environmental degradation.

Floods: Double the Devastation

Today, 25,000 people worldwide are killed each year by flooding, and many more face homelessness, disease, and crop failure following such catastrophes. Blaming such factors as deforestation, climate change, and population growth, United Nations University researchers announced in June 2004 that the number of people affected by devastating floods will double to 2 billion by 2050. Weather-related disasters cost the global economy \$50–60 billion annually, and developing countries face the highest relative death toll from these disasters.

